SCIENCE

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*VIVISECTION.**

A STATEMENT IN BEHALF OF SCIENCE.

So long ago as the autumn of 1866 there were published in New York denunciations of the practice of making upon living animals those scientific observations and ex-

* The sciences which have to do with animal experimentation are physiology, physiological chemistry, pharmacology, medical chemistry, toxicology, morphology (including anatomy and embryology), bacteriology, pathology, medicine and surgery. These sciences are largely represented in this country by the American Physiological Society, the American Society of Morphologists, the American Anatomical Society, the American Society of Naturalists, the American Society of Physicians, and the American Society of Surgeons.

In December last the presidents of the above societies were invited to appoint members of a joint committee to sit in Philadelphia on the occasion of the annual meeting in that city of several of these associations.

The accompanying 'statement in behalf of science' was adopted by this joint committee of thirty-four members, and is now published over their signatures, with the addition of several names of persons specially qualified to speak on the subject, but not members of the committee. It sets forth the importance of animal experimentation for the advancement of medicine, and may be accepted as an authoritative expression of expert opinion on this question.

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periments which are commonly called vivisections. During the following twenty-nine years there have appeared, from time to time, at one or another place, similar denunciations, more or less sweeping and violent. Of these some condemn vivisection altogether, and others in various of its phases. Some call for its total abolition, and others for its material restriction. Some are labored essays, and others are brief 'tracts' or 'leaflets' intended more easily to arrest the attention. Most of these publications, however, have this in common, that they seek to fortify argument with strenuous appeals to emotion; and in some the tone of invective rises to a shrillness little short of frantic. In these publications, too, there often figure extracts from scientific writings; and, in many cases, these extracts are so garbled that only ignorant or reckless animosity could be accepted in excuse for their seeming bad faith.

During the past twenty-nine years these attacks have but little disturbed the calm of biology and medicine in this country; but, from time to time, it has seemed wise to take some notice of them, inasmuch as the common sense of some members of a changing community is liable to be led astray as to a subject which is largely technical in its nature. The following statement, therefore, is added to its predecessors. Its signers, however, are well aware that they can hardly hope to make any statement or to draw any conclusion which some anti-vivisectionist agitator will not promptly denounce as false or immoral.

Science is simply common knowledge made precise, extended and transmitted from generation to generation of trained observers and reasoners. The biological sciences study in the most varied ways the bodies and the lives of men, of animals and of plants. The applied sciences utilize knowledge thus obtained for the every-day good of mankind; and one of these applied sciences, medicine, brings biological discoveries to bear upon the prevention and cure of disease and injury. As experience grows incessantly, the fact which has laboriously been established with no other thought than the noble one of advancing knowledge may be applied, the next day or the next century, in the most practical way by some inventor or physician; and, in the application, new facts may come to light, which will markedly extend the boundaries of knowledge.

Therefore, in the slowly woven fabric of achievement, pure science and applied science, biology and medicine, have always been warp and woof. Let either be destroyed, man's life shall go threadbare.

To show this, a few out of many striking examples may suffice.

Not very long ago the red clover was imported into a British colony to which it was not native. The plant throve, when planted; but its flowers set no seeds, so that fresh seed had to be brought from the mother country. The disappointed farmers consulted people who had given up their time to the study of plants and insects — botanists, and 'bug-hunters,' in fact. Pure science told the practical farmers that the long-billed humble-bees which sucked honey in every English clover field also carried pollen from flower to flower, and thus fertilized the plants, and that it was useless to try for crops of imported red clover, unless humble-bees were imported also.

No less enlightening is the history of one of the latest and most modern of the developments of science. Near the end of the last century Dr. Galvani, an Italian professor of anatomy, set himself to investigate the cause of a newly discovered fact: namely, that the muscles of the legs of freshly killed frogs jerked forcibly when their nerves were worked upon by the taking of a spark from an electrical machine. This investigation, which does not sound

momentous, he undertook, 'in order to discover the hidden properties' of the nerves and muscles, 'and to treat their diseases more certainly.' To the jerks of Galvani's frogs' legs we owe the discovery of the galvanic battery and current, which are named after him; the telegraph and ocean cable, with their immense influence upon civilized life in peace and war; the transfer to miles of distance of the vast working power of Niagara Falls. It is a fitting, if slight, dramatic touch that the traveller in Italy who passes the night at Bologna, where Galvani worked and taught, will perhaps put up at a hotel directly opposite the professor's modest house, and will see that the tablet which records the experiments made within is lighted up at evening by the electric light, which also owes its existence to a search for the hidden 'properties' of frogs' legs.

Two hundred years ago there lived at Delft, in Holland, a well-to-do Dutchman, named Antony van Leeuwenhoek. He had been a 'dry goods clerk' in his youth, and had had no learned or professional training. Van Leeuwenhoek took to making and polishing, for his own use, very small and very strong magnifying glasses, because he was full of what some anti-vivisectionists sneer at as 'scientific curiosity.' The Dutchman's glasses were very superior; and with them he looked at the most miscellaneous things—among these, at ditch water and at particles from the surface of his own teeth. He found that such matters were swarming with living things of all kinds, and described them and other things so well that he became famous, and princes, who were not ashamed to be interested in 'mere science,' sent for him and his glasses to instruct them. Among Van Leeuwenhoek's discoveries were the minute things now called bacteria, or microbes, and known to be living plants. The physicians were prompted to guess that diseases might be due to the ravages of the new forms of microscopic life first seen with decisive clearness by Van Leeuwenhoek; but no proof of this was forthcoming, and the idea was abandoned by most, amid the laughter of many at this fad of the doctors. More than a century went by. The bacteria, as objects of pure science, were more and more studied. The microscope was bettered more and more from the simple magnifying glass of Van Leeuwenhoek. With the advance of chemistry and of other sciences, all known means of studying minute living things became greatly improved; and now the idea that many diseases were caused by minute living things was taken up afresh, and carried to triumphant demonstration by a number of medical men and biologists —among the latter by Pasteur, whose recent loss is mourned by the world, and whom an eminent American humanitarian sneered at, not many years ago, as an 'obscure druggist.' The proof that many diseases are caused each by a particular kind of microbe was obtained by vivisection; for the proof consisted in inoculating animals with the special microbe in question, to the practical exclusion of others, and noting that the animals took the disease, perhaps died of it. As some only of the results of the knowledge thus gained by experiment upon animals, it may be noted that the prevention of cholera has been made more certain, and that great numbers of patients, largely children, have been saved from death by the anti-toxine treatment of diphtheria. But every child thus saved to-day owes his life, not only to medicine, but to biology; not only to the observations and the vivisections of Klebs and Loeffler and Koch and Pasteur and others, but to the 'mere scientific curiosity' of that old lens-polisher of Delft, who spent time in prying into ditch water and particles from the surface of teeth.

Early in the last century, at a country

parsonage in England, there worked a pious and gifted man, the Rev. Stephen Hales, D. D., Rector of Farringdon, in Hampshire. Dr. Hales achieved the uncommon distinction of becoming both an excellent clergyman and a famous biologist. Nor was it to any easy branch of observation that he gave such time as he could spare, but to difficult themes of experimental physiology, both vegetable and animal. He studied, among other things, the pressure of the sap in plants and the pressure of the blood in the vessels of animals. In order to investigate the blood pressure, he did a number of indispensable vivisections upon horses, sheep and dogs. Each animal was tied down, an artery was opened and connected with a pressure gauge, and the true pressures and their variations were for the first time properly observed and recorded. No doubt, had it been possible, the excellent Hales would have drugged his animals to quiet their pain; but modern methods for this purpose were not discovered till long afterward, so that in those days both man and beast faced the surgeon's knife without such relief as they afford. By the work of Hales our knowledge of the circulation of the blood, which his famous compatriot Harvey had discovered, received an essential addition; nor is there reason to suppose that Hales ever doubted the morality of the proceedings by which he satisfied his 'scientific curiosity.' Were he to return to life and to repeat his experiments, even with all modern improvements, he certainly would be surprised at the reception he would meet with in some quarters.

Since the time of Hales those changes in the blood pressure have carefully been studied which are produced in various states of the system and by various drugs. More than a century after Hales some vivisections were performed by Mr. Arthur Gamgee, to test the effect upon the blood pressure of a certain volatile chemical—the nitrite of amyl. It was found that the pressure appeared to be greatly lessened by this drug. Some of these experiments were witnessed by Dr. T. Lauder Brunton, at that time resident physician to the Royal Infirmary at Edinburgh, and now an eminent medical practitioner and professor in London. During the winter of 1866–67 there were in the wards of the infirmary several patients who suffered from the disorder called breastpang, or angina pectoris, which is characterized by paroxysms of hard breathing and of terrible pain over the heart. In observing these cases, Dr. Brunton saw reason to think that the attack was accompanied by a high blood pressure in the arteries. He remembered the vivisections in which he had seen the effects upon the arterial pressure of the nitrite of amyl. He caused his patients to inhale a few drops of the volatile drug. The pain generally disappeared; and the nitrite of amyl became very soon a recognized agent for the relief of one of the most acute forms of human suffering.

Every victim of angina who carries this drug about with him for use at any moment owes his exemption, first, to the scientific physician; second, to the pharmacologist—that is, the scientific student of the action of drugs, who, for the good of man, sacrificed animals in studying the effect of drugs upon the blood pressure; and third, to the clergyman and physiologist, Hales, who a century before had given some pain to animals in studying the science of the circulation, apart from any direct application to the cure of human ailments. Nor is this all; for the experiments of Hales were based upon the knowledge acquired through vivisection by the physician Harvey, who by this means settled much relating to the motions of the heart and blood in animals; which settlement, in turn, depended upon the work of the famous Greek physician,

Galen, who seventeen centuries ago proved by vivisections, against his professional opponents, that blood is naturally contained in the arteries.

Of the numerous improvements in practical medicine and surgery which are the outcome of experiments upon living animals we could not speak at length without expanding a brief statement into a book. We will instance further only the vivisections by which, at the time of the Napoleonic wars, Dr. J. F. D. Jones ascertained the proper way to tie up a wounded artery, and thereby afforded the means to military and civil practice of saving very numerous patients from bleeding to death; the experiments of the still living surgeon, Sir Joseph Lister, as the result of which surgery has been revolutionized in our own day; the quite recent vivisections, as the result of which the cure of the disease called myxœdema has been discovered, which cure consists in the administration or transplantation of the thyroid gland; and the vivisections in the seventeenth century relating to the transfusion of blood, as the result of which women in child-bed have repeatedly been rescued from impending death from 'flooding after delivery.'

Experience shows, therefore, that it is impossible to disentangle pure science from applied science; that vital human interests are benefited by 'scientific curiosity,' as well as by work more directly practical; and that this general law holds good for those sciences, pure and applied, which deal with man as such, and with the other living things upon the earth. Without physiology, pathology and their allies, which investigate the laws of life by experiments upon living creatures, practical medicine would be in worse than mediæval plight; for before the Middle Ages the genius of the Greeks had inaugurated the practice of experimental physiology, with results of value for all time.

Therefore, the use of animals by mankind for scientific purposes take its place beside those other uses of them for the good of man which involve imprisonment, enforced labor, death, and, in some cases, suffering. That society asserts with practical unanimity the right to kill and inflict pain upon animals for its own purposes is shown by the legal view of cruelty as the unjustifiable infliction of suffering. Were every infliction of pain as such punishable as cruel, the painful operations, for instance, required to make animals docile, or to fit them to be food, would be abolished. In every great civilized country these operations of the farmyard aggregate millions in each year.

Happily, of the very various procedures known collectively as vivisections, many are painless; in others the suffering is trivial, whether the animal be killed or remain alive; and in the great majority of the rest some drug may be given to quiet pain, or insensibility may be produced by sudden operation. There remains, however, a limited portion of cases, which may be of great importance, where the results of experiment would be endangered by any means that could be taken against suffering. In these cases the animal must suffer, though often far less than would be supposed, for the benefit of man as does the gelded horse or the wounded game.

Common sense requires, therefore, that investigations in biology and medicine shall proceed, at the expense, when necessary, of the death and suffering of animals. If these sciences are not to be extinguished they must be transmitted from generation to generation; they must be taught, and like all the other natural or physical sciences; they must, at institutions of the higher learning be taught by demonstration. No one would think favorably of a student of chemistry who had never handled a test-tube, or of a student of electricity who had

never set up a battery. The young astronomer sees the stars and planets themselves through the telescope. So do serious students of biology or medicine see for themselves the structure of the body, see for themselves the workings of that structure through the experiments of the physiological or pathological laboratory or lecture room, just as medical students, they see disease in the wards of hospitals, and look on or assist at the surgical operations performed upon men, women and children. No models and pictures can replace such teaching. From this last fact there is no escape. It is rooted in the constitution of the human mind. No mother would knowingly allow her childern to ride behind a locomotive engineer who had never seen the workings of an actual engine. Surely the physician who does his best to guide the living mechanism along the path of safety should be taught its natural workings as exactly and as fully as possible; otherwise he may understand its working in disease.

Happily the cases where the animals seen at demonstrations must undergo more than brief or trival pain are even rarer than in cases of pure research. In the very great majority of demonstrations the creatures can be kept free of pain until they are killed. As to whether or no, under given circumstances of research or teaching, an experiment involving pain should be performed, is a matter which should rest with the responsible expert, by whom or under whose direction the thing would be done. Otherwise, in a matter involving the interest of the community, those who know would be directed by those who do not know. For any experiment improperly conducted the person responsible is liable under the general laws against the maltreatment of animals. In fact, American biologists and physicians are no more inclined than other members of the community to culpable negligence toward their fellow-creatures. The work of science goes on; but those who are responsible desire, and see to it, that the work be painless, so far as admissible. No intelligent man or woman should give heed to the denunciations of those few ill-informed or headstrong persons who have been drawn into one of the less wise of the agitations which beset modern society.

Signed: S. Weir Mitchell, J. G. Curtis, W. H. Howell, H. P. Bowditch, W. T. Porter, J. W. Warren, R. H. Chittenden, V. C. Vaughan, John Marshall, S. B. Ward, William Pepper, S. C. Busey, Henry M. Lyman, E. G. Janeway, Ch. Wardell Stiles, William Patten, William T. Sedgwick, H. C. Ernst, Theobald Smith, A. C. Abbott, J. J. Abel, A. R. Cushny, H. C. Wood, Frank Baker, Harrison Allen, G. A. Piersol, C. S. Minot, Henry F. Osborn, C. O. Whitman, William H. Welch, T. M. Prudden, R. H. Fitz, George M. Sternberg, J. Rufus Tryon, Walter J. Wyman, Daniel E. Salmon, G. Brown Goode, W. W. Keen, William Osler, J. Collins Warren, W. T. Councilman.

CERTITUDES AND ILLUSIONS: AN ILLUSION CONCERNING REST.

Twenty centuries of investigation have dispelled many illusions. In examining the folklore of the world it is found that the lower the stage of culture the greater the number of these illusions. Since systematic researches were inaugurated by the Greeks many have been explained, yet some remain, even in the scientific world of today. On the threshold of our work it becomes necessary to dispel an illusion developed by primordial men and handed down through sequent generations to the present time, so that even now there are few minds unclouded by its mystic presence. When the ball is in the hand it seems to be at rest; when it flies from the hand motion seems to be created; and when it stops upon the